

17. (Currently Amended) ~~The method of claim 12~~ A method for producing a centralizer, the method comprising the steps of:

providing a length of metal tubular work piece, the work piece having a longitudinal axis, a sidewall and a central opening, inside a confining surface comprised of first and second mold elements, each of the mold elements having a cylindrical sidewall, inner and outer ends, a slot extending from its inner end, the mold elements having their inner ends in abutment such that the slots mate at the inner ends to a configuration of a side wall centralizer rib, the mold elements being supported within a housing assembly substantially against expansion radially outward from their position about the tubular work piece;

inserting a mandrel having a cylindrical exterior into the tubular work piece and sealing between an outer diameter portion of the mandrel and an inner diameter portion of the tubular work piece to define a sealed annular space between the mandrel and the tubular work piece;

applying sufficient fluid pressure to the annular space to force the tubular sidewall radially outward against the confining surface and into the mold cavities to plastically deform the side wall to form centralizer ribs on the side wall;

removing the tubular work piece from the confining surface;

wherein the confining surface further comprises:

a cylindrical bell having a tapered bore therein with a larger inner diameter at one end of the bell than at another end of the bell;

a collet having a tapered outer surface that mates with the inner diameter of the bore, the mold elements being located within the collet; and

removing the tubular work piece from the confining surface comprises:

moving the collet axially relative to the bell; then

removing the tubular work piece along with the mold elements from the collet.

18. (Currently Amended) The method of claim 4217 wherein:

each mold element has a cylindrical inner diameter and an end that abuts an end of an adjacent one of the mold elements; and

each cavity has a portion extending to one of the ends of the mold elements, the portions of the cavity joining each other.

19. (Previously Amended) The method of claim 18 wherein the mold elements contain axially extending slits to permit their circumferential expansion.

20. (Currently Amended) The method of claim ~~12~~17 wherein the step of sealing between an outer diameter portion of the mandrel and an inner diameter portion of the tubular work piece comprises placing annular seals between the tubular work piece and the mandrel at axially spaced apart distances.

21. (Currently Amended) The method of claim ~~12~~17 wherein upon removal of the centralizer from the confining surface, the tubular work piece sidewall is of substantially uniform thickness.

22. (Currently Amended) The method of claim ~~12~~17 further comprising applying a friction-reducing coating to the tubular work piece inner diameter portion once the tubular work piece has been removed from the confining surface.

23. (Currently Amended) The method of claim ~~12~~17 further comprising treating exterior surfaces of the ribs to increase their wear resistance once the tubular work piece has been removed from the confining surface.

24. (Currently Amended) The method of claim ~~12~~17 wherein removing the centralizer from the confining surface includes expanding the mold elements to overcome their hoop stress.

25. (Currently Amended) The method of claim ~~12~~17 wherein the ribs are formed to protrude smoothly from the sidewall cylindrical outer surface.

26. (Cancelled)

27. (Currently Amended) A method for producing a centralizer for a pipe comprising:

providing a tubular work piece selected to be formed into the centralizer having a central opening defining an inner diameter and a sidewall having an inner-facing surface directed toward the central opening and an outer-facing surface;

providing a mold including a plurality of two mold elements, each being a tubular member having an inner end and an outer end, each mold element having a plurality of elongated slots, each with an opening at the inner end, each slot having a length extending toward the outer end, together forming an inner surface defining a substantially cylindrical confining space and cavities formed in the inner surface positioned and configured so as to correspond to the position and configuration of ribs to be formed on the centralizer;

positioning the tubular work piece in the mold elements and the mold elements such that the inner ends of the mold elements abut each other, the openings of the slots in one of the mold elements mate with the openings of the slots in the other of the mold elements to define cavities with perimeters shaped like centralizer ribs  
~~tubular work piece is within the substantially cylindrical confining space formed by the mold elements;~~

providing a bell with a chamber having a longitudinal chamber axis;

placing~~inserting~~ the mold elements and the tubular work piece together along the chamber axis and into the chamber within a the bell; then

applying sufficient fluid pressure against the sidewall to force the sidewall out against the mold elements and into the cavities of the mold elements to form a centralizer having ribs protruding outwardly from its outer surface;

removing the centralizer and the mold elements from the bell by moving the centralizer and the mold elements along the chamber axis; then

removing the mold elements from the centralizer by sliding the mold elements in opposite axial directions relative to a longitudinal axis of the centralizer.

28. (Currently Amended) The method of claim 27 wherein the step of ~~placing~~inserting comprises:

inserting a mandrel into the central opening of the tubular work piece such that an annular space is formed between the mandrel and the sidewall inner facing surface;

sealing about the annular space; and

the step of applying sufficient fluid pressure includes introducing fluid pressure to the annular space.

29. (Original) The method of claim 27 wherein the fluid pressure is air pressure.

30. (Original) The method of claim 27 wherein the fluid pressure is hydraulic pressure.

31. (Cancelled)

32. (Currently Amended) The method of claim ~~30~~27 wherein the mold elements contain axially-extending slits to permit their circumferential expansion while being removed from the centralizer.

33. (Previously Amended) The method of claim 27 wherein the mold further comprises:

a tapered bore in the bell with a larger inner diameter at one end of the bell than at another end of the bell;

a collet having a tapered outer surface that mates with the inner diameter of the bore, the mold elements being located within the collet; and

removing the tubular work piece from the bell comprises:

moving the collet axially relative to the bell; then

removing the tubular work piece along with the mold elements from the collet.

34. (Original) The method of claim 27 wherein each mold element defines a portion of a cavity.

35. (Original) The method of claim 27 wherein the mold elements contain slits to permit their circumferential expansion.

36. (Previously Amended) The method of claim 27 wherein upon removal of the centralizer from the bell, the centralizer sidewall is of substantially uniform thickness.

37. (Previously Amended) The method of claim 27 further comprising applying a friction reducing coating to the centralizer inner surface once the centralizer has been removed from the bell.

38. (Previously Amended) The method of claim 27 further comprising treating exterior surfaces of the ribs to increase their wear resistance once the centralizer has been removed from the bell.

39. (Original) The method of claim 27 wherein removing the mold elements from the centralizer includes expanding the mold elements to overcome their hoop stress.

40. (Cancelled)

41. (New) A method for producing a centralizer, the method comprising the steps of:

(a) providing a length of metal tubular work piece, the work piece having a longitudinal axis, a sidewall and a central opening;

(b) inserting the work piece inside a confining surface comprised of two mold elements, each of the mold elements having a unitary cylindrical sidewall, inner and outer ends, a plurality of elongated slots, each slot extending along the sidewall and having an opening at the inner end and a termination spaced from the inner end, the mold elements having their inner ends in abutment with each other such that the openings of the slots mate at the inner

ends to define elongated mold cavities, each cavity having a configuration of a desired side wall centralizer rib;

(c) inserting a mandrel having a cylindrical exterior into the tubular work piece and through the mold elements, and sealing between an outer diameter portion of the mandrel and an inner diameter portion of the tubular work piece to define a sealed annular space between the mandrel and the tubular work piece;

(d) inserting the mold elements, the work piece, and the mandrel into a chamber of a housing assembly;

(e) applying sufficient fluid pressure to the annular space to force the tubular sidewall radially outward against the confining surface and into the mold cavities to plastically deform the side wall to form centralizer ribs on the side wall; then

(f) removing the mold elements, the mandrel, and tubular work piece from the chamber in the housing assembly; then

(g) sliding the mold elements in opposite axial directions relative to each other, removing them from the work piece.

42. (New) The method according to claim 41, wherein:

the chamber of the housing assembly has a cylindrical inner diameter that has a chamber axis;

step (d) comprises inserting the mold elements and the work piece along the chamber axis into the chamber; and

step (f) comprises withdrawing the mold elements and the work piece along the chamber axis.

43. (New) The method according to claim 41, wherein step (b) comprises providing each of the mold elements with an axial length greater than an inner diameter of each of the mold elements.

44. (New) The method according to claim 41, wherein:

the housing assembly of step (d) comprises a bell and a collet located within the bell, the collet and the bell having tapered mating surfaces;

the mold elements are located within a bore of the collet in step (e); and  
step (f) comprises withdrawing the collet, the mold elements, and the work piece from the bell.

45. (New) The method according to claim 41, wherein:

the mold elements contain axially extending slits to permit their circumferential expansion during step (g).

46. (New) the method according to claim 41, wherein:

the chamber of the housing assembly has open opposite ends; and  
in step (d) the mandrel protrudes from both ends of the chamber.